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ABSTRACT

Computer enhanced teaching of computational mathematics on a network system driving graphics terminals is being redeveloped for a mouse-driven, high resolution, windowed environment of a UNIX work station. Preservation of the features of networked access by heterogeneous terminals is provided by the use of the X Window environment. A dmonstrator program has been developed which exhibits interactive access over an Ethernet network and displays the use of B splines for curve fitting. The control of the coordinates by the mouse button allows points to be added or deleted or dragged to a new position while a C program produces the display of the fitted curve. Screen icons control transformations of the curve and permit instant repositioning. Multitasking permits comparison of the results of alternative algorithms in adjacent windows. True format mathematical text, which can be called from a HELP button, is viewable in another window. (Author/DB)

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MOUSE DRIVEN WINDOW GRAPHICS FOR NETWORK TEACHING

by

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MOUSE DRIVEN WINDOW GRAPHICS FOR NETWORK TEACHING

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ABSTRACT

Computer enhanced teaching of computational mathematics on a network system driving graphics terminals, is being re-developed for a mouse driven, high resolution, windowed environment of a UNIX workstation. Preservation of the features of networked access by heterogeneous terminals is provided by the use of the X Window environment. A demonstrator program has been developed which exhibits interactive access over an Ethernet network and displays the use of B splines for curve fitting. The control of the coordinates by the mouse button allows points to be added or deleted or dragged to a new position while a C program produces the display of the fitted curve. Screen icons control tranformations of the curve and permit instant repositioning. Multitasking permits comparison of the results of alternative algorithms in adjacent windows. True format mathematical text, callable from a HELP button, is viewable in another window.

BACKGROUND

A project to develop teaching software for computational mathematics has been underway at the University of Kent for a number of years. By making use of the campus ring network it has been possible to devise software written in C to run on a host UNIX supermicro giving multiple access from around the whole campus. To create the software in C an authoring system was devised which converted the dialogue of the teaching programme and the calls to external routines into a C program. (ref 1)

The work places strong emphasis on providing graphical illustrations to give a dynamic view of algorithmic behaviour. Another important feature which has been incorporated allows the user a choice to input both parameters and arbitrary functions interactively at run time. (ref 2)

Progress through the program is determined from pop up menus although some use is also made of commands. Graphics is highly machine dependent and to overcome this a device independent graphics system DIGS, developed at Heriot Watt University, was used to produce a graphics format file which is displayed using one of various device drivers in the host program.

DEFICIENCIES OF THE OLD SYSTEM

1. Only one display can be mounted at any one time

2. No provision can be made for input to be taken by pointing at the screen image

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IR0146 60

3. Control of the program and displays can only be made by typing in a response.

4. Mathematical text can not be displayed in full format

5. Only one program can be controlled at any one time

THE X WINDOW ENVIRONMENT

This is a distributed, network transparent, device independent multitasking windowing and graphics system (ref 3), which overcomes all of the five listed deficiencies of the old system. Morever it can display simultaneously different algorithms for the same problem in different windows which may overlap. X achieves device independence by using a combination of client and server programs with the server program in the individual workstation displaying the windows and graphic objects. The client program may reside in the same workstation or be resident in some far distant linked workstation of a different manufacturer. By sending packets of instructions conforming to the X protocol it is not necessary to send the full pixel information. The server can perform two dimensional drawing on monochrome or colour displays and can also load fonts, store them and allow them to be used for the production of text.

An X server program can service requests from many client applications and hence the screen could display several windows containing output from different client programs which are running on different machines. The windows are overlapped according to a hierarchy in which "children" windows always appear in front of their "parents" and a stacking order governs "siblings" of the same level. Applications that use the library, X lib, for all the windowing and drawing should be portable to any hardware that supports an X server, by simple recompilation of the code. The programs at Kent have been ported from the Sun to a Dec 3100 workstation to an Archimedes R140.

To make programming easier there are X Toolkits, built out of X lib functions. These toolkits are in C and provide object-oriented structures in the form of widgets that hold information about the state of graphical objects.

CAL DEMONSTRATOR APPLICATION

To show the versatility of the X Window environment an application program has been written to display the curve fit achieved by a B spline algorithm which fits piecewise cubics to a set of control points. Changes to the control points only affect the local behaviour of the fitted curve. The B spline fitted curve does not necessarily pass through the control points but its properties make it suitable for computer graphics design. (ref 5)

THE USER INTERFACE

Interaction is established using the mouse as a control device acting on a graphical interface with boxes and menus. The menu-items and the boxes represent functions which are available to the user and these border the window of the plane coordinate system. The menu bar at the top of the window contains the entries FILE, OPTIONS, CHANGE and QUIT, each of which contain submenus which become visible when the main box is selected. After clicking on a submenu option and holding down the mouse

button, the user can make a choice from the displayed submenu by moving the pointer to the right option and releasing the button. The menu at the right border of the window is application dependent whereas the top menu boxes are not. Choice and movement of control points is also pointer controlled from within the window. A tektronic window under X allows the existing DIGS software to be used alongside the new, but the limitations of the old software do of course remain.

1. G.J. Makinson & H. Morarji Computer Educ. Vol II No.1 pp 47-52 (1987)

2. G.J. Makinson & H. Morarji Int. J. of Math. Educ. in Science and Technol Vol.18 No.6 pp 817-820 (1987)

3. G.J. Makinson & H. Morarji Int. J. of Comput. Applic. in Technol. Vol 2 No.2 pp 124 -126 (1989)

4. D. Pountain The X Window System, Byte, - Jan 1989 pp 353-360

5. C.F. Gerald and P.O. Wheatley - Applied Numerical analysis Addison-Wesley 1989.

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The X Window system is a trademark of the Massachusetts Institute of Technology.

Figure 1.